2

SUSTAINABILITY

SURVIVABILITY

SUPPORTABILITY

TECHNICAL REPORT
NATICK/TR-89/020

AD ______________

AD-A205 547

CHEMICAL SANITATION SYSTEM FOR POTS AND PANS IN FIELD OPERATIONS

BY

WAYNE S. MULLER
MORRIS ROGERS
DARRELL SEEKINS
RAYMOND YOUNG

FEBRUARY 1989

FINAL REPORT
APRIL 1985 - SEPTEMBER 1988

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED

UNITED STATES ARMY NATICK
RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
NATICK, MASSACHUSETTS 01760-5000
SCIENCE AND ADVANCED TECHNOLOGY DIRECTORATE

DISCLAIMERS

The findings contained in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

Citation of trade names in this report does not constitute an official endorsement or approval of the use of such items.

DESTRUCTION NOTICE

For Classified Documents:

Follow the procedures in DoD 5200.22-M, Industrial Security Manual, Section II-19 or DoD 5200.1-R, Information Security Program Regulation, Chapter IX.

For Unclassified/Limited Distribution Documents:

Destroy by any method that prevents disclosure of contents or reconstruction of the document.

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release, distribution unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NATICK/TR-89/020	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION U.S. Army Natick RD&E Center 6b. OFFICE SYMBOL (If applicable) STRNC-YMT	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Natick, MA 01760-5020	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U.S. Army Natick RD&E Center 8b. OFFICE SYMBOL (If applicable) STRNC-YMT	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) Natick, MA 01760-5020	10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
63747	D610	26	N/A

11. TITLE (Include Security Classification)

(U) Chemical Sanitation System for Pots and Pans in Field Operations

12. PERSONAL AUTHOR(S)

Wayne S. Muller, Morris Rogers, Darrell Seekins and Raymond Young

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
final	FROM 4/85 TO 9/88	February 1989	28

16. SUPPLEMENTARY NOTATION

17. COSATI CODES		
FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

SANITATION, HALOGENS, DISHWASHING COMPOUNDS, DETERGENTS, WATER, WATER CONSERVATION, CLEANING, COLD WATER, LOW TEMPERATURE (over)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This study was initiated by the Air Force with the objective to develop a chemical sanitation system which would effectively clean and sanitize pots and pans in the field. Two requirements were addressed: 1) a need to clean and sanitize in cold water temperatures (15^{o} - 25^{o}C), and 2) a need to reduce the amount of water required for cleaning pots and pans in the field. The prototype developed did not satisfactorily perform in a field test. Though the item developed did not perform to expectations, it was determined that the overall system for cleaning and sanitizing has merit. The difficulty with the product developed was not in sanitizing in cold water but in removing grease at these low water temperatures. At this time there is no commercial product or combination of products available that can clean pots and pans effectively at these cold water temperatures.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Wayne S. Muller	22b. TELEPHONE (Include Area Code) (508) 651-4596 22c. OFFICE SYMBOL STRNC-YMT

18. FIELD KITCHENS,
TEST AND EVALUATION
FIELD TESTS.

PREFACE

The work described in this report was started in April 1985 and completed in September 1988, under Program 63747A, Project No. D610, and Task 26.

The use of trade names or manufacturers' names in this report does not constitute an official endorsement or approval of the use of any commercial product. This report may not be cited for purposes of advertisement.

TABLE OF CONTENTS

LIST OF TABLES

Tables

CHEMICAL SANITATION SYSTEM FOR POTS AND PANS

IN FIELD OPERATIONS

Introduction

This study was initiated by the Air Force with the objective to develop a chemical sanitation system that would effectively clean and sanitize pots and pans in the field. Two requirements were addressed: a) the need for an effective detergent/sanitizer that cleans and disinfects in cold water (15° to $25^{\circ}C$), and b) the development of a product that reduces the amount of water needed for cleaning pots and pans.

The Air Force needs an effective detergent/sanitizer in cold water in order to counteract enemy surveillance equipment. By reducing heat-generating equipment in the field, such as the M2 burner used in field kitchens, infrared detecting devices will be less effective in locating field operations. In addition, a reduction of water requirements for cleanup would be advantageous to the military. In an arid environment water is a scarce commodity and must be conserved; detergent/sanitizer that cleans in cold water and also saves on the consumption of water would be a significant benefit in field operations.

The approach used in developing a chemical sanitation system was to evaluate commercially available detergent/sanitizers having Environmental Protection Agency (EPA) and Food and Drug Adminstration (FDA) approval for incorpration into a disposable wipe or sponge/brush. In a similar study, conducted under a work unit entitled "Eating Utensil Sanitation"

(AH99BD-009), iodine formulations were found to be very effective in sanitizing eating utensils. Based on these results, and our experience with effective chlorine formulations, the evaluation of iodine and chlorine products was given preference in this study. As will be evident from the results presented in this report, sanitizing pots and pans was not as much of a problem as the cleaning of kitchenware in cold water.

Methods

Screening of Commercial Products

The method used in testing various commercial detergent/sanitizer formulations for their sanitizing capability was a modified version of the Swab Contact Method. This method, outlined in Standard Methods for the Examination of Dairy Products,[1] is applicable when evaluating large or irregular equipment surfaces. This test has proved to be very useful in the dairy industry for detecting sanitizing failures of equipment and containers.

In testing commercial formulations, 10 mL of a corned beef soil (Appendix A) was added to clean sterile aluminum pots measuring 17.5 cm in diameter and 11.5 cm in depth. In addition, 0.5 mL of an overnight culture of Staphylococcus aureus was used to inoculate the soil. The final inoculum for each pot was 10^6 organisms/mL of soil. This soil was allowed to dry for different time intervals ranging from 20 minutes to one hour. The pot was then scrubbed and washed for 30 seconds with the detergent/sanitizer pad using 20 mL of sterile distilled H_2O. As a control, 20 mL of sterile distilled H_2O were added and the pot scraped with a sterile rubber spatula for 30 seconds. After being used in scrubbing the pot, the wash water was discarded and another 20 mL of

distilled H_2O were added as a rinse. The bottom of the pot was swabbed twice using a Calgiswab Type 2$^{(R)}$ (Spectrum Diagnostic, Glenwood, IL), a calcium alginate swab, which was then antiseptically placed into 5 mL of sterile phosphate buffer, containing 0.05% $Na_2S_2O_3$ (Appendix A). The samples were serially diluted and plated on nutrient agar (Difco, Detroit, MI). The plates were incubated for 24 h at 37°C. The commercial products were evaluated based on the percent reduction of bacteria from the cleaned surface as compared to the control surface (Table 1).

Development of Prototype

A number of different sponge/pads (Table 2) were evaluated with 10 mL of Mikroklene (Active ingredients: 15.5% Butoxypolypropoxypolyethoxy-ethanol-iodine complex, 6.5% phosphoric acid, Inert ingredient 78.0%, Economic Laboratory, St. Paul, MN) as the sanitizing agent. The most effective sponge/pad was determined by the number of plastic trays that could be cleaned and sanitized from the eight trays that were covered with a corned beef soil inoculated with S. aureus (2 x 10^6 organisms/mL soil). The trays used in this procedure have a total eating surface area of 61.69 in^2 (397.9 cm^2) with five compartments. The water for washing was limited to 40 mL; 20 mL would be used for the first four trays and 20 mL for the next four trays. The original 10 mL of Mikroklene and the sponge/pad being evaluated with the Mikroklene were used to clean all eight trays. The same Swab Contact Method was used in this procedure as in the screening of commercial products. However, due to the large surface area and number of trays, the following was used as the criterion for rating a tray clean and sanitized (from Standard Methods (1)): For

Table 1

Commercial Products Tested

Product	% Reduction of Bacteria	Active Ingredient	Manufacturer
Pre-Op Soap Tissue	99.99	Iodine Complex	Davis and Geck American Cyanamide Co. Danbury, CT
Pre-Op Surgical Scrub Sponge	99.97	Iodine Complex	" " "
Pre-Op II Surgical Scrub Sponge/Brush	99.97	" "	" " "
Truly Magic Pads	99.87	Unknown Detergent	Truly Magic Products Inc Buffalo, NY
EZ Iodophor Scrub/Brush	99.92	Iodine Complex	Not Available
EZ Hibiclens	94.27	Chlohexidine gluconate	" "
Cleaf 300 Soap Leaf Product	91.25	Triclosan	Parachem Corp. Des Moines, IA
Castile Soap Towelette	99.51	Unknown Detergent	Clinipad Corp. Guilford, CT
Tincture of Green Soap	96.32	6.6% Soap & 2% Alcohol	" " " "
Iodophor Towelette	99.99	Polxamer Iodine Complex	" " " "
Steel Wool & Benzal-konium Chloride	90.94	Benzalkonium Chloride	Not a Commercial Product

Table 2

Sponge/Pads Tested

Sponge/Pad	Manufacturer
Scotch Brite Rescue Pad	3M Company St. Paul, MN
Nylonge Kitchen Scubber & Sponge	Sponge Inc. Cleveland, OH
Cookware Scrunge Pad	Church & Dwight Corp. Princeton, NJ
Aluminum Oxide Pad	Mercury Foam Corp. Hackensack, NJ
Cellulose Sponge	National Sponge Brooklyn, NY
Household Scrunge Pad	Church & Dwight Corp. Princeton, NJ
Double Cell Ether Sponge	Scotfoam Eddystone, PA
Triple Laminate Sponge	Scotfoam Eddystone, PA

evaluating equipment, five areas of approximately 8 sq in (51.64 cm^2) each were swabbed, and trays having estimated counts not exceeding 500 organisms were considered satisfactory (i.e., averaging 12.5 colonies per sq in (6.45 cm^2) of surface).

In-House Operational Tests

In conducting two operational tests at the U.S. Army Natick Research Development & Engineering Center (Natick) Company Mess Hall, three civilians, contracted for kitchen services by the Army, were requested to evaluate the cleaning performance of two pads containing Mikroklene. Before each test a number of pads were formulated with specific amounts of Mikroklene. Since different size pads were evaluated, approximately 1 mL of Mikroklene was impregnated into the sponge for every sq in (6.45 cm^2) of pad surface (i.e., a 6" x 4"(15.24 x 10.16 cm) pad had 24 mL of Mikroklene). The participants were instructed to remove all loose food debris from items being cleaned before using the sanitizing pads. The amount of water to wash the item was limited to 50 mL, an amount which just moistened the sponge, so that the iodophor in the pad could be released. Following cleaning, the item was rinsed with water to remove residual iodine. The only water to be used throughout the procedure was from the cold water tap, which was approximately 24°C. After using the sanitizing pad for 20 minutes the person performing the operational test was asked to fill out a questionnaire evaluating the performance of the products.

Field Test

A field test was arranged thru Mr. Glen Daugherty, Tyndall Air Force Base, Florida. The test was conducted on July 22-23, 1987, at Eglin Air

Force Base, at the Det 2 Field Training Site, Fort Walton Beach, Florida. A prototype detergent/sanitizer sponge/pad was evaluated for its effectiveness in the field by military personnel training at the site. The detergent/sanitizer pad to be field tested, which will be referred to as Prototype II, consists of two commercial products. One of the products, Mikroklene, is a sanitizer used for kitchen surfaces and dishwashers. The other product, used to apply the Mikroklene for cleaning and sanitizing, is a sponge/pad having an aluminum oxide abrasive surface and a sponge side made of polyurethane (Mercury Foam Corp., Hackensack, NJ). The pots and pans for four meals were cleaned and sanitized using the detergent/sanitizer pad. The cleaning and sanitizing was conducted in the new Harvest Eagle Dining Facility having the three sink method for cleaning kitchenware(2). At each meal served, three people were assigned to cleaning pots and pans.

Before each meal, personnel doing the cleaning were briefed on the use of the detergent/sanitizer pad. The first person would scrape all loose food debris from the pots and pans. The next person would wash the kitchenware with the detergent/sanitizer pad. The third person rinsed the cleaned pots and pans of all residual iodine. The participants rotated positions every 20 to 30 minutes so that each participant handled the detergent/sanitizer pad. The person doing the washing was required to wear safety goggles and gloves as outlined in the toxicity clearance report of the Office Of The Air Force Surgeon General (3).

During the cleaning process, no hot water was used. For the first meal, a lunch, an unlimited amount of cold water was permitted to be used to determine how well the item would clean. In addition, during the last

three meals the amount of water used during cleaning was monitored. The water usage was monitored to determine if the system would have the added advantage of saving water. In washing pots and pans, only enough water was used to wet the detergent/sanitizer pad and release the iodophor. Twenty gallons (75.6 liters) of water were used to fill the prerinse and rinse sinks, which accounted for the bulk of the water used in cleaning. The water in the prerinse and rinse sinks was changed when dirty, as determined by the test subjects doing the cleaning.

The amount of water used in these tests was based on a worst case scenario, an arid environment, as outlined in AF Phamphlet 140-4(4). According to the pamphlet a soldier is allowed 2.35 gal/day (8.83 liters) of water for kitchen cleanup or 0.78 gal/meal (2.95 liters) in an arid environment. In a nonarid environment the water use planning factor is 2.5 times greater then what is allowed in an arid environment, approximately 5.88 gal/day (22.21 liters). The limit for determining if the detergent/sanitizer pad was saving water was calculated by multiplying the number of people served by 0.78 gal/meal (2.95 liters). In addition to monitoring the amount of water, the temperature of the water was also recorded. To vary the temperatures for cleaning pots and pans at the four meals, ice was added to the prerinse and rinse water for meals three (breakfast) and four (lunch). The menus for each of the four meals used in the tests, the water limit, the temperature of the water used, and the number of people served at each meal are contained in Table 4.

Storage Tests

Storage tests were conducted on the more effective commercial products. The products tested were stored in screw cap jars at two

Table 3

Meals Served at Field Test Site

Lunch (Meal #1)
Food Served: Knockwurst, sauerkraut, buttered rice, BBQ chicken, succotash, and green beans.
People Served: 180
Water Temperature: 83°F(28.3°C)
Water Used: Unlimited

Dinner (Meal #2)
Food Served: Chicken a la king, braised beef cubes, rice, brown gravy, peas, ranch styled beans, tossed salad, and macaroni.
People Served: 70
Water Temperature: 85°F(29.4°C)
Water Limit: 55 gallons(207.9 liters)

Breakfast (Meal #3)
Food Served: Grilled Sausage, scrambled eggs, hash browns, creamed beef, french toast, and buttered grits.
People Served: 230
Water Temperature: 54°-59°F(12.2°- 15°C)
Water Limit: 180 gallons(680.4 liters)

Lunch (Meal #4)
Food Served: Grilled steak, BBQ chicken, baked potatoes, corn on the cob, buttered peas, and sauteed mushrooms.
People Served: 230
Water Temperature: 60°-70°F(15.6°-21.1°C)
Water Limit: 180 gallons(680.4 liters)

temperatures, 25° - $50^{\circ}C$. For the first week of storage the item was evaluated for deterioration every day then again after the first month of storage and finally every three months or until a deterioration problem was detected. The longest test conducted on a product was for two years.

Results

Screening Commercial Products

A number of commercial products already containing a sanitizer and/or detergent were evaluated for their effectiveness in cleaning and sanitizing pots and pans under the conditions of these tests. Table 1 lists some of the more effective products tested, as well as their sanitizing capabilities (percent reduction), the active ingredient(s), and the manufacturer.

The three best candidates, the Pre-Op Soap Tissue, Pre-Op Surgical Scrub Sponge, and Pre-Op II Surgical Scrub Sponge/Brush, had a iodophor as their active ingredient. All three products exhibited very good sanitizing capabilities as indicated in Table 1, based on percent reduction of bacteria. However, disadvantages were observed for each of the candidates in their storage stability and/or cleaning performance of soiled surfaces. The Pre-Op Soap Tissue did not have the abrasive qualities necessary to clean pots and pans and, at best, one tissue could sanitize only one piece of cookware. The testing of Pre-Op Surgical Scrub Sponge was discontinued because of the deterioration of the pad after two years of storage at $25^{\circ}C$. The Pre-Op II Surgical Scrub Sponge/Brush had many advantages. It had good abrasive properties for cleaning, each one was individually wrapped, and there was a large amount of iodophor present

to clean effectively a number of trays. The disadvantages of the scrub/brush were its bulkiness, its shelf life of only two years, and its poor flexibility in cleaning corners and irregular surfaces of pots.

Other commercial products evaluated that had some type of iodine complex as the active ingredient also tested well as sanitizers. However, products without an iodine complex as the active ingredient did not exhibit the same high percent reduction of bacteria as shown in Table 1. These products not only exhibited poor sanitizing efficacy but also did not adequately clean soiled metal surfaces.

Development of Prototype

It was evident from the screening of commercial products that iodine complexes were effective sanitizers. However the commercial products available lacked the abrasive properties necessary to clean pots and pans at cold water temperatures. To develop an effective sanitizing system, it was necessary to combine a commercial iodophor formulation with a sponge that had the abrasive properties necessary to clean pots and pans in the field.

Two iodophor products were evaluated for their sanitizing capability, Mikroklene (Economic Laboratory Inc., St. Paul, MN), which contains a butoxypolypropoxyethanol-iodine complex with a titratable iodine concentration of 1.75%, and Scrub (West Chemical Product, Inc., New York, NY) containing a poloxamer-iodine complex having a titratable iodine level of 0.75%. By impregnating a number of sponges with each product the two disinfectants could be evaluated for their sanitizing capabilities.

Mikroklene proved to be the better sanitizer because the Scrub product contained a lathering component, which had a deleterious effect on its sanitizing action.

The Mikroklene was added to different types of sponge/pads (see Table 2) to evaluate their cleaning and sanitizing properties. Table 3 summarizes the results of some of the better candidates that were tested for these properties. The Cookware Scrunge Pad was a better candidate then the Triple Laminate Sponge, even though the latter did sanitize and clean one more tray then the Cookware Scrunge Pad. The reason for the selection of the Cookware Scrunge Pad over the Triple Laminate Sponge was that it has a more abrasive surface, which is an asset in cleaning hardened food debris on pots and pans. Prototype I consisted of the Cookware Scrunge Pad and the iodophor sanitizer Mikroklene.

In-House Operational Tests

Two operational tests were conducted at the Natick Company mess hall using Prototype I. The tests were run to determine pad dimensions, cleaning capability and overall acceptability of the system. Results of the operational test allowed us to make necessary changes in the pad before field testing. The Cookware Scrunge Pad was replaced by an aluminum oxide pad made of the same sponge material as the Scrunge Pad but with a different abrasive surface, Prototype II. The aluminum oxide abrasive surface of the new pad was favored by the test subjects evaluating the two pad types. A number of pad sizes were evaluated including, 3.5" x 3.0" (8.89 x 7.62 cm), 3" x 5" (7.62 x 12.7 cm), 6" x 4" (15.24 x 10.16 cm), and 6" x 6" (15.24 x 15.24 cm). The best pad size was

Table 4

Cleaning/Sanitizing Capability of Four Sponges With 10 mL of Mikroklene

Product	Trays Effectively Sanitized	Total Area Sanitized	Number of Org. Last Tray
Household Scrunge Pad	2 Trays	123.4 sq in ($795.9\ cm^2$)	10
Cellulose Sponge From National Sponge	3 Trays	185.1 sq in ($1193.9\ cm^2$)	1
Cookware Scrunge Pad	4 Trays	246.8 sq in ($1591.9\ cm^2$)	310
Triple Laminate Sponge From Scotfoam	5 Trays	308.5 sq in ($1989.8\ cm^2$)	220

Inoculum: 2.0×10^6 organism/mL soil
Tray Size: 61.7 sq in ($398\ cm^2$)
Acceptability Level For One Tray: < 500 Organisms
Method: Swab Contact Technique

3" x 5" (7.62 x 12.7 cm). The test subjects felt that the system was acceptable under emergency situations when only cold water was available for cleaning.

Field Test

Prototype II was evaluated for its effectiveness in the field by military personnel training at the test site. Seven male and two female test subjects participated in the evaluation. The nine subjects were food service personnel from Prime Ribs (Readiness in Base Services). Their length of time in the military service ranged from four months to 18 years, with the mean time in service of 4 years and 8 months. The subjects were told to disregard the goggles and gloves they had to wear in evaluating the product, since a final formulation would be developed to alleviate these two restrictions. Each person was interviewed and filled out a questionnaire concerning the tested item. Data obtained were statistically analyzed using a numerical rating system from one to seven. The mean and standard deviations were determined for the numerical answers given to each question.

Results of the field test are summarized in Tables 5-7. Table 5 "Rating for Ease of Use for Various Tasks" indicated that the only task viewed as being slightly difficult was opening the package. Table 6 "Performance Ratings for Varying Characteristics of Detergent/Sanitizer Pad" showed most performance characteristics were assigned a "neutral" rating, neither very good or very bad. As shown in Table 7 "ease of use" and "overall performance" were rated as slightly better than neutral and the time required to wash pots and pans was viewed as slightly bad. These ratings tend to indicate a marginal acceptability of the product.

Results of Field Test

Table 5

Ratings for Ease of Use for Various Tasks.

Tasks	Mean	Std Dev	N
Opening package	4.8	2.3	9
Dispensing onto sponge	2.6	2.2	9
Application of appropriate amount of water	2.4	2.1	9
Getting iodophor on all parts of item to be cleaned	2.8	1.5	9
Overall application	2.6	1.2	9

Scale Used: One is very easy, seven very difficult.

Table 6

Performance Ratings for Varying Characteristics of the Detergent/Sanitizer Pad.

Characteristics	Mean	Std Dev	N
Scouring ability of sponge	3.9	1.5	9
Rinsing of iodophor from pot/pans	4.2	1.8	9
Cleaning effectiveness	4.6	1.4	9
Overall care of cleaning	4.1	1.1	9
Durability of sponge	4.2	1.7	9

Scale Used: One is very bad, seven very good.

Table 7

Acceptability Ratings for Use, Performance and Time.

Characteristics	Mean	Std Dev	N
Ease of Use	4.6	2.1	9
Overall performance	4.3	1.5	9
Time required to wash pot/pans	3.3	1.5	9

Scale Used: One is very bad, seven very good.

However, care must be taken in making generalizations about the product because of the small sample size and the variability in the response scores.

In a seperate question, respondents were asked to provide evaluative information on varying sponge characteristics. The results show that the majority of the subjects found the sponge to be "just right" with respect to thickness, length, and width. In the interview of the participants it was observed by some that the aluminum oxide surface of the sponge/pad deteriorated after 15 minutes of use with the iodophor. In addition, several participants indicated that there was some difficulty in cleaning small areas with the sponge.

Discussion

It was evident from our results in screening commercial products (Table 1) and from our previous experience under the work unit "Eating Utensil Sanitation" (AH99BD-009), that an iodophor product would be an effective sanitizer in cold water. However the difficulty we experienced in the field test was not sanitizing but cleaning the combination of grease and cold water. Before an item can be sanitized the cleaning process must be effective. In the laboratory evaluation of the cleaning capability of products, results were based on subjective methods of analysis, unlike the quantitative sanitizing results. The cleaning efficacy of a product was determined by observations such as: how clean a utensil looked after washing, how the product handled on various eating surfaces, how many trays could be cleaned with the product, and how well the product held up during cleaning.

One reason for conducting the operational tests at the Natick mess hall was to evaluate the prototypes in a more realistic situation. This situation provided an opportunity to have experienced people, involved in the daily clean-up in a mess hall kitchen, evaluate the item with the usual equipment that would be cleaned in a field kitchen. This test also provided unbiased input on the system performance so that modifications could be made if necessary, prior to field testing. There were a few comments that the cleaning process did take a little longer then the usual method of cleaning in hot water; however, the additional time was not seen as a significant problem. In addition, a comment was made that a few of the items were not as clean as usual. They were, however, determined to be acceptable. It was our opinion, from observing the cleaning process, and also the opinion of the participants, that Prototype II would be an acceptable item for the cold water cleaning of pots and pans under emergency situations.

In the field test conducted at Eglin Air Force Base the results were not as favorable for Prototype II as in the operational test. In evaluating the ease of use results in Table 5, the only apparent difficulty was opening the iodophor packets used in the test. Difficulty in handling the trilaminated packaging system was expected, since it was a "make do" system until finalizing of the sanitizing formulation. The difficulty in opening the iodophor packets was amplified with the requirement to wear gloves. Most of the participants needed some assistance in opening the packets. Finally, for the last two meals we opened the packets for the person doing the washing. However, this

problem is minor and can easily be resolved by a new packaging material, dependent on the composition of the final sanitizing formulation.

The overall response to Prototype II was neither favorable nor poor (see Table 7). The inability of the iodophor formulation to cut grease in cold water was the source of many of the negative comments (a problem not encountered in the operational tests). In general, pots and pans that were put through the cleaning cycle once had to be redone to remove the grease film. In the third and fourth meal where ice was added to the water to lower the temperature, the removal of grease became even more difficult. With this added difficulty in cleaning pots and pans for the third and fourth meals, a portion of the pots and pans had to be cleaned by other means to prevent a backup into the preparation of the next meal.

As stated, the major source of difficulty in cleaning the pots and pans was the sanitizing formulation. However, there was an additional problem with the pad's aluminum oxide surface. A similar sponge/pad was used in Prototype I, the Cookware Scrunge Pad, which was composed of the same sponge material as Prototype II; however, it had a different abrasive surface. This Scrunge Pad did not have the same type of scouring capability as the aluminum oxide pad (Prototype II), which was the reason it was not selected for the field test; however, in a two-year storage test with Mikroklene, the item showed no sign of deterioration. On the other hand, the aluminum oxide pad showed signs of deterioration within a week when impregnated with Mikroklene. It was thoucht that this deterioration problem could be resolved by packaging the iodophor separately. Evidently the reaction between the aluminum oxide surface and the iodophor occurs more rapidly than determined in storage tests and in

the operational tests. The Cookware Scrunge Pad may be a good alternate pad to the aluminum oxide pad upon the development of an improved sanitizing formulation.

In evaluating the water consumption of Prototype II, the water used for washing and rinsing was monitored for the last three meals of the field test. For the second meal clean up, all the pots and pans were cleaned with the pad. In this case, 51 gallons (192.8 liters) of water were used versus a calculated water limit of 55 gallons (207.9 liters) for meal clean up. With a portion of the pots and pans in the third and fourth meals having to be cleaned by other means, it became difficult to accurately determine whether Prototype II saved water. Estimates of water use were made for meals three and four. It was determined that there was no significant conservation of water as compared to the normal system of cleaning. However, even though Prototype II did not save water, it was important that the system developed did stay within the strict water limits stated in AF Pamphlet 140-4(4). Considering the normal system of cleaning is with hot water, quite unlike Prototype II, which is limited to cold water cleaning, maintaining these strict water limits is an advantage for the developed cleaning system.

After screening a number of different detergent/sanitizers in an attempt to find a replacement or an additive to Mikroklene, it became evident that there was nothing commercially available that can effectively remove grease in cold water temperatures. The Air Force Liaison Officer at Natick, Major Deborah Page, concurred with this conclusion and amended the requirement for cold water(5). The amended requirement is to find the minimum temperature at which Prototype II or another detergent/sanitizer

can alleviate the grease problem in cleaning pots and pans. In the author's opinion the temperature necessary to cut grease will be over 100°F (37.8°C). With this higher temperature the iodophor complex will be very volatile, which will reduce its sanitizing effectiveness (the product should not be used in water temperatures above 120°F(48.9°C)). If a water temperature is required much above 100°F(37.8°C), a new detergent/sanitizer should be developed, and at that point even the need for such an item in the field may be in question. At such high temperatures the requirement for a sanitizing system that is effective in cold water is no longer being addressed and reducing heat generating equipment for field operations will be negligible.

Conclusion

The prototype developed for a "Chemical Sanitation System for Field Operations" did not satisfactorily perform in a field test. Though the item developed did not perform to expectations, it was determined that the overall system for cleaning and sanitizing has merit. The difficulty with the product developed was not in sanitizing in cold water but in removing grease at these low water temperatures. At this time there is no commercial product or combination of products available that can clean pots and pans effectively at cold water temperatures. However a minimum temperature can be determined, with modification in the developed prototype, that can satisfy the needs of the Air Force for a chemical sanitizer in the field.

Appendix
Soil and Buffer Ingredients

<u>Corned Beef Test Soil</u>
25 oz (715 g) Corned Beef Hash
17 oz (486.2 g) Golden Sweet Cream Style Corn
6 oz (17.16 g) Brown Gravy
1/8 lb (57.2 g) Butter
1/4 lb (114.4 g) Lard
3 Extra Large Brown Eggs
7 oz (200.2 g) Sweetened Condensed Milk

Final pH 5.8

<u>Stock Phosphate Buffer Solution.</u>
34 g Potassium Dihydrogen Phosphate
Dissolved in 500 mL dH_2O
Adjust to pH 7.2 with 1N NaOH
Bring volume to 1 liter with distilled H_2O

<u>Phosphate Buffer</u>
1.25 mL Stock Phosphate Buffer
0.5 g Sodium Thiosulfate
10.0 g Sodium Citrate
1.0 mL Tween 80

Bring volume to 1 liter with distilled H_2O

References

1. Standard Methods For the Examination of Dairy Products Microbiological and Chemical. Eleventh Edition. American Public Health Association, Inc. 1960.

2. NAV MED P-5010, Bureau of Med. and Surgery Dept. of Navy, Washington DC, 1978.

3. Consultative Letter, 87-065EO196ETB, USAF Occupational and Environmental Health Laboratory (AFSC), Brook Air Force Base, Texas, 18 May 1987.

4. Department of the Air Force, The Prime Ribs Manager's Handbook, Air Force Pamphlet 140-4, Sept. 1983.

5. Memorandum for the Record, Subject: With Air Force Liaison Officer on MSR1490, 2 Aug 1988.